FBI Laboratory
Firearms/Toolmarks Unit
Shot Pattern Examinations in Muzzle-to-Target Distance Determinations

1 Scope

This procedure is to provide a comprehensive protocol when performing muzzle-to-target distance determinations based on shot patterns.

2 Equipment/Materials/Reagents

Stereozoom binocular microscope (magnification range 10X-20X), steel tape measure, target materials, hearing protection, target backing materials, eye protection, and ammunition.

3 Standards and Controls

Lead bullets are used as a positive control for the Sodium Rhodizonate test. Nitrites test swabs are used as a positive control for the Modified Griess test. Copper jacketed bullets are used as a positive control for the Modified Dithiooxamide (DTO) test.

4 Calibrations

Not applicable.

5 Sampling

Not applicable.

6 Procedures

6.1 Microscopic and Visual Examination

6.1.1 Although shot patterns in victim garments and other objects are normally microscopically examined and chemically processed to detect residues such as nitrite compounds, copper and lead due to "pellet wipe," the basis for most distance determinations is the size of the shot pattern and its reproduction. Patterns produced by shot pellets will be elongated in some cases due to the fact that an angle other than 90 degrees existed between the barrel of the weapon and the area of impact. In this situation, the narrower dimension is the significant dimension as a

basis for comparison with the size of known-distance patterns.

6.1.2 It is also important to note that a shot pattern is not necessarily the product of a shotgun having been fired, at least in the case of the smaller shot sizes. Handgun "snake" loads are common in a variety of calibers. In addition, during the microscopic examination it is possible that fine plastic particulate, typically black or white, will be found. This material would be indicative of the discharge of a shotgun as some types of shotshells use it as a filler material.

6.1.3 In the case of a non-circular (off-center) shot pattern, if the examiner determines it to be appropriate, the angle of the pattern should be measured.

6.2 Chemical Residues and their Processing

6.2.1 In the chemical processing of shot patterns, the same procedures used with suspected bullet holes are used, with the additional considerations outlined below. At the examiner's discretion, the Modified Griess Test, DTO Test and Sodium Rhodizonate Test should be performed because it is possible that a shot pattern may contain another bullet hole or other residues. Although it may be possible to detect vaporous lead and nitrite residues as a result of a shotgun discharge in close range shots, it is normally the pattern of shot which will be the best indicator of the muzzle-to-target distance. Further, attention should be paid the possibility of "pellet wipe" and lead randomly deposited by the impact of wadding materials. Although these types of deposits are not specifically useful in distance determination, they certainly can provide corroboration.

6.2.2 The specific techniques for conducting the Modified Griess Test and the Sodium Rhodizonate Test are the subject of other procedures.

6.3 Known-Distance Tests

6.3.1 When reproducing shot patterns detected on evidence items, it is essential that the suspect weapon and ammunition highly similar to the suspect ammunition be used in the known-distance tests. It is recommended that the known-distance targets be fired in target material affixed to a cardboard backing material.

6.3.2 When reproducing residue patterns, fire known-distance targets to produce patterns that are both smaller and larger than the patterns found on the submitted evidence. Producing smaller and larger residue patterns makes it possible to "bracket" the evidence pattern. The "bracket" should be wide enough to account for differences expected in commercially manufactured ammunition and variations normally expected from shot to shot.

6.3.3 In the case of non-circular patterns, the examiner may attempt to reproduce the pattern by firing at different distances and angles.

7 Calculations

Not applicable.

8 Uncertainty of Measurement

Not applicable.

9 Limitations

While shotguns are known to produce consistent shot pattern results under controlled conditions, variables including barrel length, barrel choke and shotshell design can all influence the size and distribution of shot patterns present on the submitted evidence and test-fired exemplars. Accordingly, shot pattern test results are primarily used to exclude particular muzzle-to-target ranges and should only be considered valid for the particular combination of shotgun and type of shotshell used during testing in the Laboratory.

Distance determinations involving a wound and/or injury are outside the scope of this procedure.

10 Safety

Follow the same procedure set forth in the Modified Griess test and Sodium Rhodizonate test procedures, as well as range safety procedures for the test firing of firearms.

11 References

SWGGUN.org, Guidelines for Gunshot Residue Distance Determinations.

Dillon, J.H., "Graphical Analysis of the Shotgun/Shotshell Performance Envelope in Distance Determination Cases," AFTE Journal, 1989: 21(4):593-594.

Dillon, J.H., "Protocol for Shot Pattern Examinations in Muzzle-to-Target Distance Determinations, " AFTE Journal, 1991; 23(1):511-521.

Lekstrom, Julie A., Koons, Robert D. Ph.D., "Copper and Nickel Detection on Gunshot Targets by Dithiooxamide Test," *Journal of Forensic Sciences*. JFSCA, Vol.31, No. 4, Oct. 1986. pp. 1283-1291.

Schous E. Clara, "A Sequence of Chemically Specific Chromophoric Tests for Nitrite Compounds, Copper, and Lead in Gunshot Residues," AFTE Journal, vol. 31, no.1, 1999.

FBI Laboratory Quality Assurance Manual

FTU Quality Assurance Manual

FBI Laboratory Safety Manual

Rev. #	Issue Date	History
0	07/10/06	Original issue for ASCLD/LAB-*International* accreditation
1	11/05/07	Removed reference to standards in section 3. Updated Section 4 to remove stereomicroscope calibrations.
2	05/02/13	Section 9 expanded limitations statement. Section 11 added reference.

Approval

Redacted - Signatures on File